Title:	**Surface/Tidal Irrigation System**
Sector	**Agriculture**
Sub-Sector	**Rice Culture**
Technology Characteristics	
Introduction	In surface irrigation systems, water moves over and across the land by simple gravity flow in order to wet it and to infiltrate into the soil. In The Gambia it is often called Tidal/flood irrigation when the irrigation results in flooding or near flooding of the cultivated land. Historically, this has been the most common method of irrigating agricultural land in The Gambia. Where water levels from the irrigation source permit, the flow is controlled by dikes, usually plugged by soil. This is often seen in terraced rice fields (rice paddies), where the method is used to flood or control the level of water in each distinct field. The Gambia River rises in Guinea and passes through Senegal before finally entering The Gambia for an approximately 500 km journey to the sea. The flow in the river is highly seasonal. The maximum flow occurs at the end of the rainy season in late September or October with a flow of about 1500 m3/s. The minimum dry season flow is less than 4.5 m3/s.Both measurements were taken at Gouloumbo in Senegal. Due to the large variation in river flow and the flat nature of the country's terrain, the Gambia River is tidal, and thus saline, for much of its length. The position of the interface between the freshwater and saltwater varies with river flow. During the low flow period, the freshwater-saltwater interface, defined as the point at which the salinity is 10 ppt, is 250 km from the sea. Under high flow conditions, this interface is located 150 km from the sea. Due to the perpetually saline conditions which exist in the Gambia River and its tributaries for 150 km from its mouth, where the population centres and tourism facilities are located, surface water is rarely used as a source of potable water in The Gambia. The potable water demand for urban areas, tourism, industry, and irrigation and livestock watering comes from groundwater sources. Groundwater is available in all parts of The Gambia. The country is located on one of the major sedimentary

	basins in Africa often referred to as the Mauritania/Senegal Basin. It is characterized by two main aquifer systems with water table depths varying from 10 m to 450 m.
Technology characteristics/Highlights[4]	This technology is intended to supplement rain fed agriculture. The availability of tidal water at high tide was used as source of irrigation water supply. Due to the use of this technology, a double cropping of rice is achieved annually in a country with seven months of dry season. The land along the Gambia River is relatively flat, and, since the river is tidal all through its length in The Gambia, tidal irrigation schemes become feasible. Tide heights vary from 3.5 m at the mouth of the river to 0.9 m at Basang, 310 km upstream. Special intake structures were constructed with gates which, when opened at high tide, allowed tidal waters to enter irrigation channels leading to the farms. During high tide, the gates were opened from 3 to 24 hours, depending on the size of the area to be irrigated. In the two rice growing areas, at Jahally and Pacharr, tidal and pump irrigation are coordinated. Tidal heights of 1.3 and 1.0 exist in the Gambia River at Jahally and Pucharr, respectively (Figure 45). Tidal water is utilized to irrigate low lands nearer the banks of the river while water is pumped from the river to irrigate large areas of land at higher elevations. The project began operations in 1983 and 1984 at Jahally and Pacharr, respectively.
Institutional and Organization requirements	The Irrigation and Agricultural Engineering Services of the Department of Agriculture are responsible for management of Tidal irrigation in The Gambia. Due to frequent staff attrition human capacity building will be needed for the expansion and management of irrigate areas Additional Farmers and Farmer Associations will be recruited and capacitated.
Operation and maintenance	Trained local staff must be available to perform the farming operations and management. Additional manpower needed to implement this technology include: (a) one power tiller operator for each 15 ha cultivated per month; (b) two tractor operators; and, (c) two experienced mechanics. There should be about 20% local community control or management.
Endorsement by experts	The technology is appropriate in areas where there is a river with a relatively flat basin and high tide intrusion. Arable land must be available near the banks of the river. The rainfall in the area must be sufficient to encourage constant and high river flows. The technology is also good for use in areas with fairly large rivers and sufficient rainfall to keep the water level high. The rivers must also be tidal.
Adequacy for current climate	Tidal irrigation is adequate under current climate for about half the length of the river. This may change under projected climate change due the upstream extension of the saline front.
Scale/size of beneficiary group	Tidal irrigation is applicable in the eastern half of the length of the River Gambia where many of the stakeholders are engaged in rice cultication.
Disadvantages and disadvantages	This technology is good because once the intake structures and irrigation channels are constructed the operation is relatively cost free. Maintenance work on the irrigation channels and clearing of weeds and brush from the channels and irrigated area can be done by the local farmers. However, difficulty in the availability of spare parts locally is a disadvantage.
Capital Costs	
Cost to implement adaptation technology	Annual cost may be estimated at $40/ha and operation and maintenance costs are $220/ha/yr. With a resultant yield per hectare of 9 tons/yr, translates to incurring an annual cost per unit of output of $70/ton.
Development Impacts, direct and indirect benefits	
Direct benefits	Rice farmers are engaged in cultivation and generate income throughout the year.
Indirect benefits	
Reduction of vulnerability to climate change impacts	According to the Second National Communication of The Gambia, there is less impacts of climate change on irrigated rice as water and temperature are currently not limiting factors.
Economic benefits: employment, growth and investment	Stakeholders are able to sell their products and generate income. Most of the employees in the cultivation of the rice fields are citizens of the region.
Social benefits: Income	Stakeholders own most of the rice fields and are involved in rice cultivation. The rice produced is used for consumption and as cash crop. Thus, socially the technology is found viable and helps the farmers to have enough food and cash for other social benefits such as for health and education purposes.
Environmental benefits:	The breeding of mosquitoes and snails is enhanced by water ponding on the farms, which could lead to public health concerns if control measures are not imposed.
Local context	
Opportunities and Barriers	The technology is appropriate in Gambia because the river basin is relatively flat with high tide intrusion during the rainy season. Both banks of the River provide adequate arable land in the freshwater zone of the river. The rainfall in the area is sufficient to encourage constant and high river flows during the wet season.
Market potential	Farmers in all the settlements close the flat lands of the freshwater zone of the Central River Region can adopt the tidal irrigation technology. All that is required is the construction of canals through which the tide flows into the crop fields and the construction of sluice gates that will be close when the tide withdraws keeping the water in the fields. There are potentials for the business and private sector entities to be involved in the manufacture and/or importation of spare parts for the constriction and maintenance of the canals and the gates.
Status	The tidal irrigation technology has been successfully practiced in the upper reaches of the River Gambia for many years and is a good for paddy rice cultivation in the Central River Region of the country. Using tidal irrigation, double cropping of 167 ha and 850 ha was achieved annually at Jahally and Pacharr.
Timeframe	The technology is applicable in the CRR around Kuntaur and Sapu throughout the year.
Acceptability to local stakeholders	No cultural inhibitions have been experienced. This technology provides for viable commercial farming in a poor rural area.
Images of Tidal Irrigation	

[4] *http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-8a/gambia.asp*